

**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

Application of: Amin *et al.*

Confirmation Number: *To be determined*

Serial No.: *To be determined*

Group Art Unit: *To be determined*

Filed: On even date herewith

Examiner: *To be determined*

For: METHODS FOR CONTROLLING  
QUBITS

Attorney Docket No.: 706700-999186

**INFORMATION DISCLOSURE STATEMENT**

Mail Stop: PATENT APPLICATION  
Commissioner for Patents  
P.O. Box 1450  
Alexandria, Virginia 22313-1450

Sir:

In accordance with the duty of disclosure provisions of 37 C.F.R. §1.56, there is hereby provided certain information which the Examiner may consider material to the examination of the subject U.S. patent application. It is requested that the Examiner make this information of record if it is deemed material to the examination of the application.

1. Enclosures accompanying this Information Disclosure Statement are:

1a. ☒ A list of all patents, publications, applications, or other information submitted for consideration by the office.

1b. A legible copy of :

☐ Each U.S. patent application publication and U.S. and foreign patent;

☒ Each publication or that portion which caused it to be listed on the PTO-1449; copies of U.S. patents and U.S. patent application publications have not been enclosed, since the U.S. Patent and Trademark Office has waived the requirement under 37 CFR 1.98 (a)(2)(i) for submitting a copy of each cited U.S. patent and U.S. patent application publication for all U.S. patent applications filed after June 30, 2003;

☒ For each cited pending U.S. application, the application specification including the claims, and any drawing of the application, or portion of the application which caused it to be listed on the PTO-1449 including any claims directed to that portion;

☐ all other information or portion which caused it to be listed on the PTO-1449.

1c. ☐ An English language copy of search report(s) from a counterpart foreign application or PCT International Search Report.

1d. ☐ Explanations of relevancy (ATTACHMENT 1(d), hereto) or English language abstracts of the non-English language publications.

2. ☒ This Information Disclosure Statement is filed under 37 C.F.R. §1.97(b):
- ☒ Within three months of the filing date of a national application other than a continued prosecution application under §1.53(d);
  - ☐ Within three months of the date of entry of the national stage as set forth in §1.491 in an international application;
  - ☐ Before the mailing of the first Office action on the merits;
  - ☐ Before the mailing of a first Office action after the filing of a request for continued examination under §1.114.
3. ☐ This Information Disclosure Statement is filed under 37 C.F.R. §1.97(c) after the period specified in 37 C.F.R. §1.97(b), but before the mailing date of any of a final action under 37 C.F.R. §1.113, a notice of allowance under 37 C.F.R. §1.311 or an action that otherwise closes prosecution in the application.

*(Check either Item 3a or 3b)*

- 3a. ☐ The Certification Statement in Item 5 below is applicable. Accordingly, no fee is required.
- 3b. ☐ The \$180.00 fee set forth in 37 C.F.R. §1.17(p) in accordance with 37 C.F.R. §1.97(c) is:
- ☐ enclosed
  - ☐ to be charged to Jones Day Deposit Account No. 503013.

*(Item 3b to be checked if any reference known for more than 3 months)*

4. ☐ This Information Disclosure Statement is filed under 37 C.F.R. §1.97(d) after the period specified in 37 C.F.R. §1.97(c), but on or before the date of payment of the issue fee.
- The \$180.00 fee set forth in 37 C.F.R. §1.17(p) is:
- ☐ enclosed.
  - ☐ to be charged to Jones Day Deposit Account No. 503013.

The Certification Statement in Item 5 below is applicable.

5. ☐ Certification Statement (applicable if Item 3a or Item 4 is checked)

*(Check either Item 5a or 5b)*

- 5a. ☐ In accordance with 37 C.F.R. §1.97(e)(1), it is certified that each item of information contained in this Information Disclosure Statement was first cited in a communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of this Information Disclosure Statement.
- 5b. ☐ In accordance with 37 C.F.R. §1.97(e)(2), it is certified that no item of information contained in this Information Disclosure Statement was cited in a communication from a foreign patent office in a counterpart foreign application and, to the knowledge of the undersigned after making reasonable inquiry, was known by any individual designated in 37 C.F.R. §1.56(c) more than three months prior to the filing of this Information Disclosure Statement.
6. ☐ This application is a continuation application under 37 C.F.R. §1.60 or §1.53(b)

or (d).

*(Check appropriate Items 6a, 6b and/or 6c)*

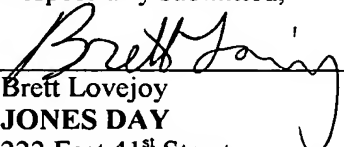
- 6a. ☐ A Petition to Withdraw from issue under 37 C.F.R. §1.313(b)(5) is concurrently filed herewith.
- 6b. ☐ Copies of publications listed on Form PTO-1449 from prior application Serial No. \_\_\_\_\_, filed on \_\_\_\_\_, of which this application claims priority under 35 U.S.C. §120, are not being submitted pursuant to 37 C.F.R. §1.98(d).
- 6c. ☐ Copies of the publications listed on Form PTO-1449 were not previously cited in prior application Serial No. \_\_\_\_\_, filed on \_\_\_\_\_, and are provided herewith.
7. ☐ This is a Supplemental Information Disclosure Statement. (Check Item 7a)
- 7a. ☐ This Supplemental Information Disclosure Statement under 37 C.F.R. §1.97(f) supplements the Information Disclosure Statement filed on \_\_\_\_\_. A bona fide attempt was made to comply with 37 C.F.R. §1.98, but inadvertent omissions were made. These omissions have been corrected herein. Accordingly, additional time is requested so that this Supplemental Information Disclosure Statement can be considered as if properly filed on \_\_\_\_\_.
8. ☐ In accordance with 37 C.F.R. §1.98, a concise explanation of what is presently understood to be the relevance of each non-English language publication is:

*( Check Item 8a, 8b, or 8c)*

- 8a. ☐ satisfied because all non-English language publications were cited on the enclosed English language copy of the PCT International Search Report or the search report from a counterpart foreign application indicating the degree of relevance found by the foreign office.
- 8b. ☐ set forth in the application.
- 8c. ☐ enclosed as an attachment hereto.
9. ☒ The Commissioner is authorized to charge any additional fee required or credit any overpayment for this Information Disclosure Statement and/or Petition to Jones Day Deposit Account No. 503013, referencing Docket No. 706700-999186.
10. ☒ No admission is made that the information cited in this Statement is, or is considered to be, material to patentability nor a representation that a search has been made (other than a search report of a foreign counterpart application or PCT International Search Report if submitted herewith). 37 C.F.R. §§1.97(g) and (h).

Date: March 2, 2004

Respectfully submitted,

  
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LIST OF REFERENCES CITED BY APPLICANT (Use several sheets if necessary)	ATTY DOCKET NO. 706700-999186	APPLICATION NO To be determined
	APPLICANT Amin et al.	
	FILING DATE On even date herewith	GROUP To be determined

## U.S. PATENT DOCUMENTS

*EXAMINER INITIAL		DOCUMENT NUMBER	DATE	NAME	CLASS	SUBCLASS	FILING DATE IF APPROPRIATE
	A01	5,323,344	6-21-1994	K. Katayama, and S. Kamohara			
	A02	5,917,322	6-29-1999	N. Gershenfeld and I. Chuang			
	A03	6,495,854 B1	12-17-2002	D. Newns, and C.C. Tsuei			12-30-1999
	A04	2002/0117656 A1	8-29-2002	M.H.S. Amin <i>et al.</i>			4-20-2001
	A05	2002/0180006 A1	12-05-2002	M. Franz <i>et al.</i>			5-31-2001
	A06	09/452,749	N/A	A.M. Zagorskin			12-01-1999
	A07	09/637,514	N/A	A.V. Ustinov <i>et al.</i>			8-11-2000

## FOREIGN PATENT DOCUMENTS

		DOCUMENT NUMBER	DATE	COUNTRY	CLASS	SUBCLASS	TRANSLATION
							YES NO

## OTHER REFERENCES (Including Author, Title, Date, Pertinent Pages, Etc.)

✓	A08	A. Aassime, G. Johansson, G. Wendin, R. Schoelkopf, and P. Delsing, "Radio-Frequency Single-Electron Transistor as Readout Device for Qubits: Charge Sensitivity and Backaction," <i>Phys. Rev. Lett.</i> 86, pp. 3376-3379 (2001).
✓	A09	D.V. Averin, "Adiabatic Quantum Computation with Cooper Pairs," <i>Solid State Communications</i> 105, pp. 659-664 (1998).
✓	A10	G. Blatter, V.B. Geshkenbein, and L.B. Ioffe, "Design aspects of superconducting-phase quantum bits," <i>Phys. Rev. B</i> 63, pp. 17451/1-9 (2001).
✓	A11	G. Blatter, V.B. Geshkenbein, M.V. Feigel'man, A.L. Faucheare, and L.B. Ioffe, "Quantum Computing with Superconducting Phase Qubits," <i>Physica C</i> 352, pp. 105-109 (2001).
	A12	Mark F. Bocko, Andrea M. Herr, and Marc J. Feldman, "Prospect for Quantum Coherent Computation Using Superconducting Electronics," <i>IEEE Transactions on Applied Superconductivity</i> 7, pp. 3638-3641 (1997).
✓	A13	F. Benatti, <i>et al.</i> , "Testing Macroscopic Quantum Coherence," <i>IL Nuovo Cimento B</i> 110, No. 5-6, pp. 593-610 (1995).
	A14	A. Blais, and A.M. Zagorskin, "Operation of universal gates in a solid-state quantum computer based on clean Josephson junctions between d-wave superconductors," <i>Phys. Rev. A</i> 61, 042308 (2000), pp. 042308/1-4.
	A15	H.-J. Briegel, W. Dür, J.I. Cirac, P. Zoller, "Quantum repeaters for communication", arXiv.org:quant-ph/9803056, pp. 1-8 (1998), website last accessed on December 18, 2001.
	A16	R. de Bruyn Ouboter, A.N. Omelyanchouk, and E.D. Vol, "Multi-terminal SQUID controlled by the transport current," <i>Physica B</i> 205, pp. 153-162 (1995).
	A17	G. Costabile, R. Monaco, and S. Pagano, "rf-Induced steps in intermediate length Josephson-tunnel junctions," <i>J. Appl. Phys.</i> 63, pp. 5406-5410 (1988).

EXAMINER	DATE CONSIDERED
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\*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609; Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

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A18	M.J. Feldman, "Digital Applications of Josephson junctions," Preprint submitted to <i>Progress of Theoretical Physics (Japan)</i> , pp. 1-16 (1997).
A19	R. Feynman, "Simulating physics with computers," <i>International Journal of Theoretical Physics</i> 21, pp. 467-488 (1982).
A20	J. Friedman, V. Patel, W. Chen, S.K. Tolpygo, and J.E. Lukens, "Quantum super-position of distinct macroscopic states," <i>Nature</i> 406, pp. 43-46 (2000).
A21	M. Götz, V.V. Khanin, H. Schulze, A.B. Zorin, J. Niemeyer, E. Il'ichev, A. Chwala, H.E. Hoenig, H.-G. Meyer, "Harmonic current-phase relation in Nb-Al-based superconductor/ normal conductor/ superconductor-type Josephson junctions between 4.2 K and the critical temperature," <i>Appl. Phys. Lett.</i> 77, pp. 1354-1356 (2000).
A22	L. Grover, "A fast quantum mechanical algorithm for database search," <i>Proceedings of the 28th Annual ACM Symposium on the Theory of Computing</i> , pp. 212-219 (1996).
A23	L. Ioffe, V. Geshkenbein et al., "Environmentally decoupled sds-wave Josephson junctions for quantum computing," <i>Nature</i> 398, pp. 679-681 (1999).
A24	J.A. Jones, M. Mosca, and R. H. Hansen, "Implementation of a quantum search algorithm on a quantum computer," <i>Nature</i> 393, pp. 344-346 (1998).
A25	P. Jonker, and J. Han, "On Quantum & Classical Computing with Arrays of Superconducting Persistent Current Qubits," Proceedings Fifth IEEE International Workshop on Computer Architectures for Machine Perception, Padova, Italy, September 11-13, 2000, pp. 69-78.
A26	A. Kitaev, "Quantum measurements and the Abelian Stabilizer Problem," arXiv:quant-ph/9511026, pp. 1-22 (1995), website last accessed on June 5, 2003.
A27	E. Knill, R. Laflamme, and W. Zurek, "Resilient Quantum Computation," <i>Science</i> 279, pp. 342-345 (1998).
A28	A.N. Korotkov and M.A. Paalanen, "Charge Sensitivity of Radio-Frequency Single Electron Transistor," <i>Appl. Phys. Lett.</i> 74, pp. 4052-4054 (1999).
A29	Y. Makhlin, G. Schön, and A. Shnirman, "Quantum-State Engineering with Josephson-Junction Devices," <i>Reviews of Modern Physics</i> , Vol. 73, pp. 357-400 (2001).
A30	Y. Makhlin et al., "Nano-electronic Circuits as Quantum Bits," 2000 IEEE International Symposium on Circuits and Systems, Emerging Technologies for the 21 <sup>st</sup> Century, Geneva, Switzerland, March 28-32, 2000, pages 241-244, volume 2.
A31	J.E. Mooij, T.P. Orlando, L. Levitov, L. Tian, C.H. van der Wal, and S. Lloyd, "Josephson Persistent-Current Qubit," <i>Science</i> 285, pp. 1036-1039 (1999).
A32	Y. Nakamura, Yu. A. Pashkin and J. S. Tsai, "Coherent control of macroscopic quantum states in a single-Cooper-pair box," <i>Nature</i> 398, pp. 786-788 (1999).
A33	T.P. Orlando, J.E. Mooij, L. Tian, C.H. van der Wal, L.S. Levitov, S. Lloyd, and J.J. Mazo, "Superconducting persistent current qubit," <i>Physical Review B</i> 60, pp. 15398-15413 (1999).
A34	R.C. Rey-de-Castro, M.F. Bocko, A.M. Herr, C.A. Mancini, and M.J. Feldman, "Design of an RSFQ Control Circuit to Observe MQC on an rf-SQUID," <i>IEEE Transactions on Applied Superconductivity</i> 11, pp. 1014-1017 (2001).
A35	R.J. Schoelkopf, P. Wahlgren, A.A. Kozhevnikov, P. Delsing, and D.E. Prober "The Radio-Frequency Single-Electron Transistor (RF-SET): A Fast and Ultrasensitive Electrometer," <i>Science</i> 280, pp. 1238-1242 (1998).
A36	P. Shor, "Polynomial-Time Algorithms for Prime Factorization and Discrete Logarithms on a Quantum Computer," <i>SIAM Journal on Computing</i> 26, pp. 1484-1509 (1997).
A37	L.M.K. Vandersypen, M. Steffen, G. Breyta, C. S. Yannoni, R. Cleve and I.L. Chuang, "Experimental realization of order-finding with a quantum computer," arXiv.org:quant-ph/0007017, pp. 1-4 (2000).
A38	C. van der Wal, A. ter Haar, F. K. Wilhelm, R. N. Schouten, C. Harmans, T. Orlando, S. Lloyd, and J. Mooij, "Quantum Superposition of Macroscopic Persistent-Current States," <i>Science</i> 290, pp. 773-777 (2000).
A39	A. Wallraff, Yu. Koval, M. Levitchev, M. V. Fistul, and A. V. Ustinov, "Annular Long Josephson Junctions in a Magnetic Field: Engineering and Probing the Fluxon Interaction Potential," <i>J. Low Temp. Phys.</i> 118, pp. 543-553 (2000).

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